

## CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
<b>Biofertilizers ALS-DSE 10</b>	4	2		2	7 <sup>th</sup> Sem	Nil

### Course Learning Objectives:

The Learning Objectives of this course are as follows:

- To develop an understanding of biological systems used as fertilizers and build skills in handling microbial inoculants.
- To understand the optimum conditions for growth and multiplication of useful microbes such as *Rhizobium*, cyanobacteria, mycorrhizae, *Azotobacter* etc.
- To understand the role of microbes in mineral cycling and nutrition of plants.
- To gain expertise in various methods of decomposition of biodegradable waste, conversion into compost and apply this knowledge and skill in their daily life.

### Learning outcomes

On successful completion of this course, a student will be able to:

- visualize and identify different types of microorganisms with a compound microscope.
- understand the classification of microorganisms according to their shape/ structure for morphological identification. Prepare and sterilize different types of culture media.
- isolate of microorganisms from the environmental samples and culture in aseptic conditions.

### Theory : 30 Hours

#### Unit 1: Introduction

**08 hours**

Introduction to microbial inoculants or biofertilizers, macro and micro nutrition of plants, chemical fertilizers versus biofertilizers; Role of seaweed liquid fertilizers, Methods and steps in mass multiplication of biofertilizers: stock culture, broth culture, growth medium, fermentation, blending with the carrier, packaging, and quality check, ISI standard specification for biofertilizers; scope of biofertilizers in India.

**Unit 2: Microbial Inoculants and Role of Cyanobacteria****09 hours**

Study of important microbial inoculants: *Rhizobium*, *Azospirillum*, *Azotobacter*, Actinorhizae; Characteristics, isolation, identification, and crop response, Role of Cyanobacteria (blue-green algae) in rice cultivation; *Azolla* and *Anabaena azollae* association, nitrogen fixation, and factors affecting growth.

**Unit 3: Mycorrhizal association****08 hours**

Types of mycorrhizal association, taxonomy, occurrence and distribution; Role of Arbuscular mycorrhizal fungi in phosphorus nutrition, growth and yield of crop plants; AMF – methods in isolation (wet sieving and decanting), identification (morphological and molecular methods). Methods of inoculum production (Pot culture and root culture).

**Unit 4: Organic farming****05 hours**

Introduction to organic farming, recycling of biodegradable municipal (domestic), agricultural and industrial waste; green manuring, bio-composting, vermicomposting and their field application.

**Practical:****(60 Hours)**

1. Study of *Rhizobium* from root nodules of leguminous plants by Gram staining method.
2. Observation of arbuscular mycorrhizal fungi from plant roots.
3. Isolation of arbuscular mycorrhizal spores from rhizosphere soil.
4. Isolation of *Anabaena* from *Azolla* leaf.
5. Study of Earthworm, *Azolla*, AMF: Arbuscules-vesicles through specimen / digital resources.
6. Study of Biocontrol methods and their application -Pheromone trap, *Trichoderma*, *Pseudomonas*, Neem etc. through digital resources.
7. Rapid test for pH,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{Cl}^-$  and organic matter of different composts.
8. Projects on any one of the following topics: *Rhizobium* technology, AMF technology, Organic farming, Bio composting, Vermicomposting, *Azolla* culture etc. (The design of the project should be such that it includes a continuous work of at least 6 Hours and a dissertation submission).

### **Essential/recommended readings**

- Kumaresan, V. (2005). *Biotechnology*. New Delhi, Delhi: Saras Publication.
- Sathe, T.V. (2004). *Vermiculture and Organic Farming*. New Delhi, Delhi: Daya publishers.
- Subha Rao, N.S. (2020). *Soil Microbiology*, 5th edn. New Delhi, Delhi: Oxford & IBH Publishers.
- Reeta Khosla (2017). *Biofertilizers and Biocontrol Agents for Organic Farming*, Kojo Press.

### **Suggestive readings**

- *Azotobacter* - Isolation and characterization - <https://youtu.be/1Z1VhgJ2h6U>
- *Rhizobium* - Identification and characterization - <https://youtu.be/jELLo-pMvc4>.
- 3-Days Online Workshop On Arbuscular Mycorrhizal Fungi - Biodiversity, Taxonomy and Propagation 19-2 (2022-01-20 at 02\_27 GMT-8) - <https://youtu.be/LKzK4IuSRc4>.
- Vayas, S.C, Vayas, S., Modi, H.A. (1998). *Bio-fertilizers and organic Farming*. Nadiad, Gujarat: Akta Prakashan.

**Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**